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Purdue School of Engineering & Technology
Mechanical Engineering

DEPARTMENT OF MECHANICAL ENGINEERING
Purdue School of Engineering and Technology

SUMMER 2006 SEMINAR SERIES

Date: Monday, August 7, 2006
Time: 11:00 – 11:30 am
Room: ET 137

Reception at 10:45 am (cookies and coffee served)

A Method for Determining Turbine Airfoil Geometry Parameters from a Set of Coordinates, Part II

ME 597 Project Presentation

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Abstract. Turbine blade cross-sections of gas turbine engines are commonly designed and defined in terms of a set of parameters such as chord length, stagger angle, trailing edge thickness, wedge angle, etc. From a specified set of parameters, a coordinate description is generated. It is sometimes advantageous to reverse this process and start with a set of section coordinates, then determine the set of design system parameters which best describes that given shape. The purpose of this project was to generate an in-house code that will match a parametrically-described airfoil to a coordinate-described target airfoil by changing the parameters systematically through numerical optimization. The code was assembled from many pre-existing in-house subroutines for optimization and shape generation, as well as new subroutines written for this project. Three test-case airfoils (given in coordinates) were matched with the project's code through optimization and the set of design parameters was determined for each airfoil. Verification of similarity between the matched airfoils to the target airfoils was based on three metrics: graphical overlay of the airfoils, numeric comparisons of geometries, and comparison of computational fluid dynamic analyses. The results show generally successful matching of all three airfoils with a few minor discrepancies, especially around the leading edge of the airfoil. The reason for these discrepancies is explained. Dependence on the initial condition is demonstrated in the third test-case airfoil. Future work for improvements to airfoil shape matching through optimization is discussed. This project was performed at an industry-leading gas turbine engine company in the Turbine Aerothermal Design group. It is in partial fulfillment for the degree of Master of Science in Mechanical Engineering for the author.

About the Speaker. Andrew White is completing a combined B.S. degree from Physics & M.S. degree from Mechanical Engineering (BPMME) at IUPUI. He has worked full/part-time since fall 2003 as a cooperative education student at Rolls-Royce Corporation (RRC). Since spring 2005 his assignment has been in the Turbine Aerothermal design group. Dr. H.U. Akay (IUPUI) and Ed Turner (RRC) have been his project mentors.